(12) UK Patent Application (19) GB (11) 2 071 257 A

(21) Application No 8008408
(22) Date of filing 12 Mar 1980
(43) Application published
16 Sep 1981
(51) INT CL³
F16L 11/08
(52) Domestic classification
F2P 1A13 1A9 1B7
(56) Documents cited
GB 1531732
(58) Field of search
F2P
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(54) **Reinforced polymeric hose**

(57) A polymeric hose and method of making same are provided wherein such hose comprises an inner base tube 12, a reinforcing braid 11 made of aramid (R.T.M.) yarn disposed concentrically around the base tube with the aramid yarn having great affinity for water, a moisture impervious tubular film 13 disposed on the braid 11, a plastisol adhesive layer 15 and a cover tube 16 with the film 13 isolating the aramid yarn and resulting in a tubular zone between the braid 11 and cover tube 16 free of water moisture created bubbles. The film 13 may be an acrylic latex.

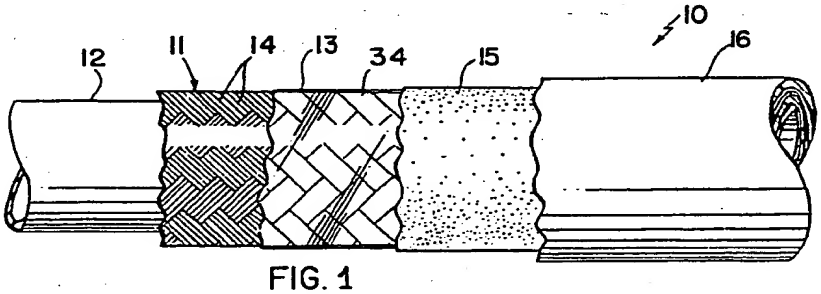

FIG. 1

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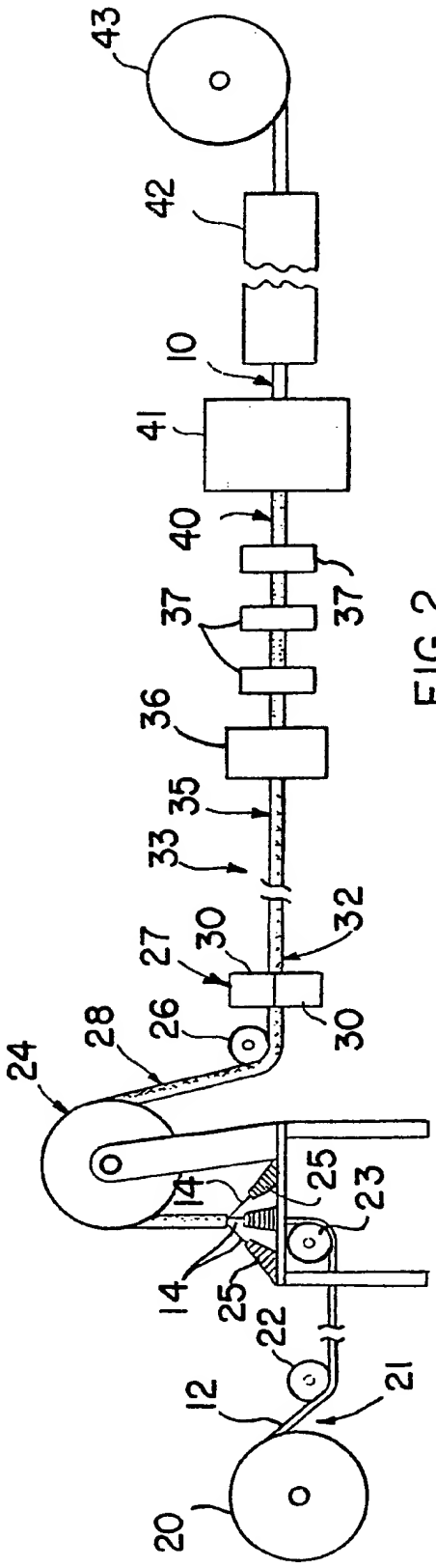

FIG. 2

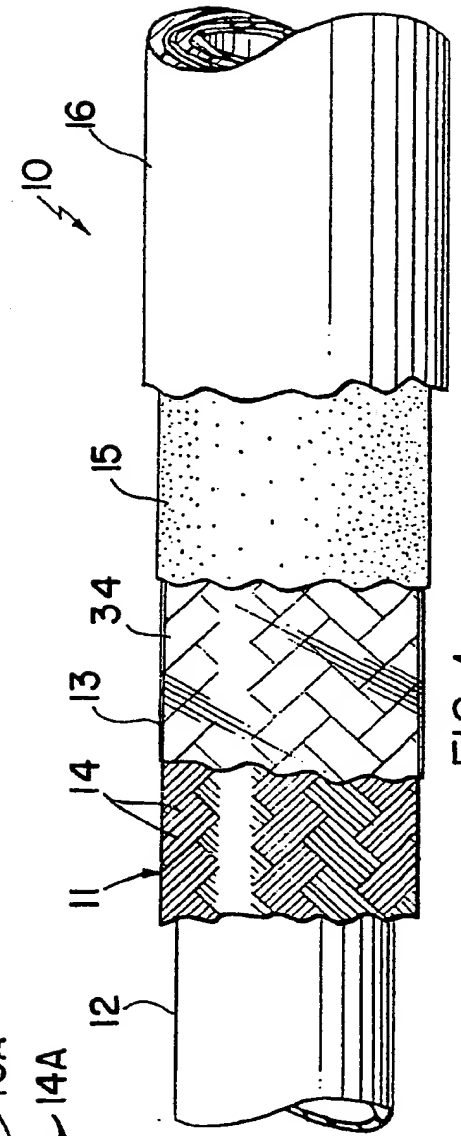

FIG. 1

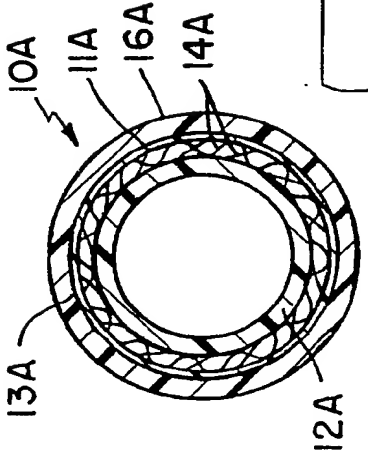

FIG. 3

SPECIFICATION

Polymeric hose and method of making same

It is known in the art to provide a hose made primarily of polymeric material and comprised of an inner base tube, a tubular braided reinforcing layer or reinforcing braid made of aramid (R.T.M.) yarn disposed concentrically around the base tube, and a polymeric cover tube disposed by extrusion process concentrically around the reinforcing braid. Because the aramid yarn of the reinforcing braid has a great affinity for water, previously proposed polymeric hose have water moisture created bubbles at the interface of the cover tube and reinforcing braid resulting in corresponding void spaces between the reinforcing braid and cover tube; this results in a hose of comparatively poor quality.

Various techniques have been proposed to solve this problem such as drying of the braided aramid yarn in a suitable oven or heat tunnel immediately before extruding the cover tube thereover; however, these techniques have not been entirely successful and even with some practical use of prior drying of the braided aramid yarn there is a tendency for water moisture to collect on the braid causing bubbles on the tubular zone between the reinforcing braid and cover tube. If the drying times and/or temperatures are substantially increased there is often permanent damaging distortion of the inner base tube.

It has also been proposed to provide a plastisol adhesive against the braided aramid yarn followed by suitably curing such adhesive as with fire rings and with the plastisol adhesive still in a hot condition a polymeric cover tube is extruded against the reinforcing braid. However, even with this approach, the great affinity of the aramid reinforcing braid for water causes beading of water droplets in the tubular zone between such braid and cover tube and the formation of bubbles in such zone.

According to the present invention there is provided a polymeric hose comprising an inner base tube, a reinforcing braid made of aramid yarn disposed concentrically around said base tube, said aramid yarn having great affinity for water, and a polymeric cover tube disposed concentrically around said reinforcing braid, the improvement comprising, a moisture-impervious tubular film disposed between said braid and cover tube, said film isolating said aramid yarn and resulting in a tubular zone between said braid and cover tube free of water moisture created bubbles.

The invention also includes a method of making a polymeric hose comprising the steps of, providing an inner base tube, braiding a reinforcing braid made of aramid yarn concentrically around said base tube, said aramid yarn having great affinity for water, and disposing a cover tube concentrically around said reinforcing braid, the improvement comprising the steps of, applying a moisture-impervious tubular film against said braid, and drying said film, said applying and drying steps being achieved prior to said disposing step, said film isolating said aramid yarn and resulting in a tubular zone between said braid and cover tube free of water moisture created bubbles.

The moisture impervious film may be an ambient air temperature dried film made of an acrylic latex.

The moisture impervious tubular film may be made of polymeric material capable of being applied in liquid form and which upon drying solidifies to define a tubular structure.

The hose of this invention may include an adhesive layer disposed between such reinforcing braid and cover tube yet with the moisture-impervious tubular film disposed between the braid and adhesive layer and serving to isolate the aramid yarn.

Following is a description by way of example only and with reference to the accompanying drawings of methods of carrying the invention into effect.

In the drawings:—

Figure 1 is a view with parts in elevation, parts in cross-section, and parts broken away illustrating one exemplary embodiment of a polymeric hose of this invention;

Figure 2 is a primarily schematic presentation with parts in elevation and parts broken away illustrating the method and associated apparatus employed in making the polymeric hose of Figure 1; and

Figure 3 is a cross-sectional view illustrating another exemplary embodiment of a polymeric hose of this invention which is similar to the hose of Figure 1.

Reference is now made to Figure 1 of the drawing which illustrates one exemplary embodiment of a hose of this invention which is made primarily of polymeric material, and thus will be referred to as a polymeric hose, and such hose is designated generally by the reference numeral 10. The polymeric hose 10 has a braided tubular layer 11 made of aramid yarn yet such hose is substantially free of water moisture created bubbles of the type which plague previously proposed hose of this type and wherein such bubbles in previous hose are disposed in a tubular zone between the reinforcing braid of aramid yarn of such hose and an adjoining layer disposed concentrically around such braid.

The polymeric hose 10 comprises an inner base tube 12 made of a suitable polymeric material preferably in the form of a synthetic plastic material and the tube 12 may be defined in accordance with any suitable technique or process known in the art such as by extrusion process, for example, whereby the tube 12 may be a seamless tube. The base tube 12 has the braided reinforcing layer or reinforcing braid 11 braided against the outside surface of such tube and as will be described in detail subsequently and has a moisture impervious tubular film 13 bonded against the braid 11 and such film extends into the interstices between individual yarns 14 of the braid. The tubular film 13 is what will be referred

to as an ambient air temperature dried film, i.e., such film is applied in liquid form and dried by exposing a length of the hose construction comprised of base tube 12 and reinforcing braid 11 with the tubular film 13 thereagainst to normal ambient temperatures and without special heating or cooling and while continuously processing the overall hose construction. The dried and solidified film 13 is effective in isolating the aramid yarn 13 disposed therebeneath.

The polymeric hose 10 also has an adhesive layer such as a cured layer of plastisol adhesive 15 disposed against the tubular film 13. A polymeric cover tube 16 is disposed concentrically around the entire construction and against the outside surface of the plastisol adhesive layer 15 and the cover tube 16 is preferably formed by extrusion against layer 15.

It is known in the art that aramid yarn has great affinity for water and in previously proposed hose of this type which do not employ moisture-impervious film such as tubular film 13 there is a tendency for the aramid yarn of any reinforcing braid to attract water moisture even through any adhesive layer disposed concentrically therearound and such moisture tends to build-up and form water beads in the area or tubular zone between the reinforcing braid and the inside surface of any polymeric cover tube extruded therearound.

However, with the utilization of the moisture-impervious tubular film 13 as taught by this invention there is no tendency for water moisture to collect and any water moisture created bubbles which might be produced are prevented from forming.

Having described the polymeric hose 10, reference is now made to Figure 2 of the drawing for a detailed presentation of the method of this invention used in making such hose. As indicated earlier, the base tube 12 is preferably made as a seamless tube by extrusion process; and, in this disclosure such tube is shown wound on a supply roll 20 thereof which is suitable supported for unwinding rotation. However, it will be appreciated that, if desired, the base tube 12 may be provided in a continuous process directly from an extruder and after moving of the hot extruded tube 12 through a cooling chamber it may be provided so that it is introduced essentially at location 21 upstream of a suitable turn roll 22.

After movement of the base tube 12 around turn roll 22 it is moved around another turn roll 23 and is then passed through a braiding machine or braider 24 for braiding of the reinforcing braid 11 around base tube 12. The braider 24 is of known construction and has a plurality of spools 25 each of which carries a length of aramid yarn 14 and the yarns 14 are braided concentrically around and against the outside surface of the base tube 12 to define the reinforcing braid 11 as a tubular reinforcing braid.

The base tube 12 with the reinforcing braid 11 braided concentrically therearound defines a hose construction 28 which is moved around a turn roll 26 to a film applying station designated generally by the reference numeral 27 where the moisture impervious film 13 is disposed in tubular form as a latex film or coating against the outside surface of the reinforcing braid 11. Although any suitable technique may be employed in applying the tubular film 13, such film is preferably applied employing a pair of so-called film wiping gaskets each designated by the same reference numeral 30 with each gasket 30 being saturated with a suitable liquid such as a latex which solidifes upon drying to define the film 13. The gaskets are saturated using any technique known in the art and such gaskets 30 have inside contours which conform to the outside configuration of the reinforcing braid 11 so that the hose construction 28 may be continuously moved through the film applying station 27 and a coating of material defining the film continuously applied to define a hose construction 32 having wet or undried film thereon.

The liquid latex defining the tubular film 13 is preferably dired at ambient air temperatures in a drying zone indicated at 33 and this is achieved by merely continuing the hose construction process while exposing a substantial length of the construction 32 to normal ambient temperatures and such substantial length is preferably of the order of 12 metres and greater. The 12 meter length of exposed construction is provided while processing the hose construction at the usual processing speeds provided by a conventional braider 23 whereby drying is achieved in a few minutes. Once dried a hose construction 35 is defined and the film 13 thereof has a substantially smooth right circular cylindrical outside surface 34 (Figure 1) and some of the tubular film 13 has portions extending into the interstices between individual yarns 14 of the reinforcing braid 11.

The hose construction 35 is then coated with a plastisol adhesive at an adhesive applying station 36 and the plastisol adhesive is cured preferably employing a plurality of fire rings each designated by the same reference numeral 37 and shown schematically as rectangular blocks to define an adhesive coated hose construction 40. The cover tube 16 is then extruded concentrically around and against the plastisol adhesive layer 15 of the hose construction employing an extrusion apparatus such as a crosshead extruder 41 and while the construction 40 is still hot whereupon the hose construction 10 is defined and exits the crosshead extruder 41. The hose construction is then moved through a cooling tank or chamber 42 of conventional construction for cooling; and, the completed and ccoled hose construction is then wound to define a supply roll 43 thereof.

The above-described technique provides tubular film 13 which effectively isolates the reinforcing braid 11 defined by braided aramid yarn 14 and results in a tubular zone between the braid 11 and the cover tube 16 which is free of water moisture created bubbles. It should also be emphasized that the plastisol adhesive layer 15 alone would not be adequate in isolating the

aramid yarn 14 defining the reinforcing braid 11 whereby the hose of this invention and the method of making such hose are unique due to the fact that the moisture impervious tubular film 13 isolates the aramid yarn in the manner described.

Another exemplary embodiment of the hose of this invention is illustrated in Figure 3 of the drawing. The hose of Figure 3 is very similar to the hose 10; therefore, such hose will be designated by the reference numeral 10A and representative parts of the hose 10A which are similar to corresponding parts of the hose 10 will be designated in the drawing by the same reference numeral as in the hose 10 followed by the letter designation "A" and not described again in detail.

The hose 10A of Figure 3 is very similar to hose 10 with the exception that the layer of plastisol adhesive is eliminated. Accordingly, the hose 10A has an inner base tube 12A, a braided reinforcing layer 11A comprised of aramid yarn 14A, a moisture impervious tubular film 13A bonded against the outside surface of the braid 11A and in the interstices between the individual yarns 14A of such braid, and a polymeric cover tube 16A extruded against the outside surface of the moisture impervious tubular film 13A. As described in connection with the hose 10, the film 13A isolates the aramid yarn 14A and results in a tubular zone between the braid 11A and the cover tube 16A which is free of moisture created bubbles.

In this disclosure of the invention each hose 10 and 10A is shown with a single layer of a tubular reinforcing braid; however, it will also be appreciated that instead of single layer of reinforcing braid around the base tube a plurality of such layers also made of aramid yarn may be provided. In this latter instance, a moisture impervious tubular film 13 may be disposed against the outside surface of each layer of reinforcing braid or against the outermost layer of reinforcing braid to thereby isolate the cover tube disposed concentrically outwardly of the braided layers from the influence of the aramid yarn layers.

The material employed in making each base tube 12 and 12A and each cover tube 16 and 16A may be any suitable polymeric material employed in the art for this purpose. Preferably each of such tubes is made of a suitable synthetic plastic material.

The aramid yarn 14 and 14A comprising each exemplary polymeric hose 10 and 10A respectively of this invention is preferably made from organic fibres within the family of aromatic polyomides. One example of a yarn that has been used successfully in hose constructions is sold by the E. I. DuPont de Nemours and Co., of Wilmington, Delaware, 19898 and sold under the registered trademark "KEVLAR". The film 13 and 13A may be made employing any suitable material known in the art which will prevent aramid yarn from attracting water moisture thereto. An example of a material that has been used successfully is an acrylic latex applied in liquid form and ambient air dried to define a solid moisture impervious tubular film. An example of a film that has been used successfully is an acrylic latex manufactured by the Charles S. Tanner Co., of and sold under the same designation of DURO CRYL 361.

However, it is to be understood that other materials may be used to define a moisture impervious polymeric film in addition to acrylic latex. For example, vinyl, latex, vinyl-acrylic latex, vinylidene chloride latex, solvent cements from vinyl acetate, urethane, and the like may also be used.

While present exemplary embodiments of this invention, and methods of practicing the same have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

CLAIMS:

1. In a polymeric hose comprising an inner base tube, a reinforcing braid made of aramid (R.T.M.) yarn disposed concentrically around said base tube, said aramid yarn having great affinity for water, and a polymeric cover tube disposed concentrically around said reinforcing braid, the improvement comprising, a moisture-impervious tubular film disposed between said braid and cover tube, said film isolating said aramid yarn and resulting in a tubular zone between said braid and cover tube free of water moisture created bubbles.

2. A hose as claimed in Claim 1 wherein said film is an ambient air temperature dried film.

3. A hose as claimed in Claim 1 or Claim 2 wherein said tubular film is bonded against said braid and in the interstices between individual yarns of said braid, said cover tubue is bonded against said tubular film, and said tubular zone is defined at the interface of said tubular film and said cover tube.

4. A hose as claimed in any preceding claim wherein an adhesive layer is disposed between said reinforcing braid and cover tube and wherein said tubular film is disposed between said braid and adhesive layer.

5. A hose as claimed in Claim 3 or Claim 4 and wherein an adhesive layer comprising a plastisol adhesive disposed against said tubular film, and said cover tube is disposed against said plastisol adhesive.

6. A hose as claimed in Claim 5 wherein said adhesive layer is a flame cured layer.

7. A hose as claimed in any preceding claim wherein said film is an acrylic latex film.

8. A hose as claimed in Claim 1 and substantially as herein described with reference to and as illustrated in the accompanying drawings.

9. A method of making a polymeric hose comprising the steps of, providing an inner base tube, braiding a reinforcing braid made of aramid yarn concentrically around said base tube, said aramid yarn having great affinity for water, and disposing a cover tube concentrically around said reinforcing braid, the improvement comprising the

steps of, applying a moisture-impervious tubular film against said braid, and drying said film, said applying and drying steps being achieved prior to said disposing step, said film isolating said aramid yarn and resulting in a tubular zone between said braid and cover tube free of water moisture created bubbles.

10. A method as claimed in Claim 9 in which said drying step comprises drying said film by exposure thereof to ambient air temperatures.

11. A method as claimed in Claim 9 in which said applying step comprises applying said tubular film immediately following said braiding step.

12. A method as claimed in any one of Claims 9 to 11 wherein the drying step comprises air drying said tubular film during movement of said inner base tube, reinforcing braid, and tubular film in a continuous manner, said air drying being achieved by exposing a substantial length of the hose construction with undried film thereon to ambient air temperatures.

13. A method as claimed in any one of Claims 9 to 12 in which said applying step comprises applying a liquid material which defines said tubular film employing wiping gaskets.

14. A method as claimed in Claim 9 wherein said applying step comprises applying a film of a liquid acrylic latex which defines said tubular film during said drying step.

15. A method as claimed in Claim 9 in which said applying step comprises applying a polymeric liquid material as a tubular film which upon drying during said drying step defines a water moisture impervious tubular shield around said reinforcing braid of aramid yarn.

16. A method of making a polymeric hose comprising the steps of, providing a polymeric inner base tube, braiding a reinforcing braid made of aramid yarn concentrically around and against said base tube, said aramid yarn having great affinity for water, providing a layer of plastisol adhesive around said braid, flame curing said adhesive layer, and disposing a cover tube concentrically around said reinforcing braid and adhesive layer, the improvement comprising the steps of, applying a moisture impervious tubular film against said braid, and drying said film, said applying and drying steps being achieved prior to said disposing step, said film isolating said aramid yarn and resulting in a tubular zone between said cover tube and braid free of water moisture created bubbles.

17. A method of making a polymeric hose as claimed in Claim 16 wherein said step of providing an inner base tube comprises extruding said base tube made of a synthetic plastic material and said step of disposing said cover tube comprises extruding said cover tube, the further improvement wherein said applying step comprises applying a film of a liquid acrylic latex which defines said tubular film during said drying step.

18. In a method of making a polymeric hose as claimed in Claim 16 wherein said step of providing an inner base tube comprises extruding said base tube made of a synthetic plastic material and said step of disposing said cover tube comprises extruding said cover tube, the further improvement wherein said applying step comprises applying a film of a polymeric liquid material as a tubular film which upon drying during said drying step defines a water moisture impervious tubular shield around said reinforcing braid of aramid yarn.

19. In a method of making a polymeric hose as claimed in Claim 16 the further improvement in which said applying step comprises applying said tubular film immediately following said braiding step.

20. In a method of making a polymeric hose as set forth in Claim 19 the further improvement in which said drying step comprises drying said film by exposure thereof to ambient air temperatures.

21. In a method of making a polymeric hose as set forth in Claim 20 the further improvement in which said drying step comprises air drying said tubular film during movement of said inner base tube, reinforcing braid, and tubular film in a continuous manner, said air drying being achieved by exposing a substantial length of the hose construction with undried film thereon to ambient air temperatures.

22. A method of making a hose as claimed in Claim 9 and substantially as herein described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.